CLEAN DEVELOPMENT MECHANISM

CDM-EB110-A05

Small-scale Methodology

AMS-I.I.: Biogas/biomass thermal applications for households/small users

Version 05.0

Sectoral scope(s): 01

United Nations
Framework Convention on
Climate Change

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1. Introduction

1. The following table describes the key elements of the methodology:

Table 1. Methodology key elements

Typical project(s)	Activities for generation of renewable thermal energy using renewable biomass or biogas for use in residential, commercial and institutional applications. Examples of these technologies that displace or avoid fossil fuel use include, but are not limited to, biogas cook stoves, biomass briquette cook stoves, small-scale baking and drying systems, water heating, or space heating systems
Type of GHG emissions mitigation action	Renewable energy: Displacement of more-GHG-intensive thermal energy generation

2. Scope, applicability, and entry into force

2.1. Scope

2. This category comprises activities for generation of renewable thermal energy using renewable biomass or biogas for use in residential, commercial, institutional applications (e.g. for supply to households, small farms or for use in built environment of institutions such as schools).[1] Examples of these technologies that displace or avoid fossil fuel use include but are not limited to biogas cook stoves, biomass briquette cook stoves, small scale baking and drying systems, water heating, or space heating systems.

3. The total installed/rated thermal energy generation capacity of the project equipment is equal to or less than 45 MW thermal.[2]

4. Each unit (e.g. cook stove, heater) shall have a rated capacity equal to or less than 150 kW thermal.[3] Projects that include units with rated capacity greater than 150 kW thermal may explore AMS-I.C. “Thermal energy production with or without electricity”.

[1] Hereafter these applications are denoted by the term ‘user’ in this document.

[2] For thermal applications of biomass/biogas, the limit of 45 MW_{th} is the installed/rated capacity of the thermal application equipment or device/s. Refer to the latest version of “General Guidelines to SSC CDM methodologies”. The manufacturers’ specifications on the installed/rated thermal output may be used. In the absence of manufacturers’ specification, the installed/rated thermal output shall be determined based on a laboratory test undertaken by a nationally approved/accredited laboratory or alternatively by a laboratory complying with the requirements of a relevant national or international standard, e.g. ISO/IEC 17025. Relevant national/international standards for testing shall be used.

[3] This is consistent with the policy of the Board to allow for simplifications using the size of units included in the project as a criterion, e.g. micro scale additionality guidelines (see annex 15 of EB 54), debundling guidelines (see annex 13 of EB 54).

2.2. Applicability

5. For the specific case of biomass residues processed as a fuel (e.g. briquettes, wood chips), it shall be demonstrated that:

   (a) It is produced using solely renewable biomass[4] (more than one type of biomass may be used). Energy use for renewable biomass processing (e.g. shredding and compacting in the case of briquetting) may be considered as equivalent to the upstream emissions associated with the processing of the displaced fossil fuel and hence disregarded;

   (b) TOOL22: Leakage in biomass small-scale project activities ~~The "General guidance on leakage in biomass project activities"(attachment C to appendix B of 4/CMP.1 Annex II) shall be followed~~has been followed to estimate leakage;

   (c) The project participant can monitor the mass, moisture content and NCV of the resulting biomass fuel, through sampling that meets the confidence/precision level of 90/10;

   (d) Where the project participant is not the producer of the renewable fuel, the project participant and the producer are bound by a contract that shall enable the project participant to monitor the source of renewable biomass to account for any emissions associated with biomass production (as per 5(b) above). Such a contract shall also ensure that there is no double counting of emission reductions.

2.3. Entry into force

6. The date of entry into force is the date of the publication of the EB 110 meeting report on 27 May 2021.

2.4. Applicability of sectoral scopes

7. For validation and verification of CDM projects and programme of activities by a designated operational entity (DOE) using this methodology, application of sectoral scope 01 is mandatory and application of sectoral scopes 13 and 15 ~~are~~ is conditional.

3. Normative references

8. Project participants shall apply the General guidelines for SSC CDM methodologies, ~~general guidelines to small-scale (SSC) clean development mechanism (CDM) methodologies~~, TOOL21: Demonstration of additionality of small-scale project activities ~~Guidelines on the demonstrating of additionality of SSC project activities~~ and TOOL22: Leakage in biomass small-scale project activities ~~general guidance on leakage in biomass project activities (attachment C to appendix B)~~ available at <http://cdm.unfccc.int/Reference/Guidclarif/index.html#meth> mutatis mutandis.

[4] Refer to EB 23, annex 18 for the definition of renewable biomass.

9. This methodology also refers to the latest approved versions of the following approved methodologies and tools:

(a) "Standard for sampling and surveys for CDM project activities and programme of activities";

(b) "AMS-I.C.: Thermal energy production with or without electricity";

(c) "AMS-III.D.: Methane recovery in animal manure management systems".

4. Definitions

10. The definitions contained in the Glossary of CDM terms shall apply.

5. Baseline methodology

5.1. Project boundary

11. The project boundary is the physical, geographical sites of the equipment producing thermal energy during the crediting period.

5.2. Baseline emissions

12. The baseline is the fuel consumption of the thermal application used or that would have been used in the absence of the project activity times an emission factor for the fossil fuel displaced.

5.3. Emission reductions

13. The emission reductions of the project activity shall be determined ~~using one of the options below~~ based on thermal energy generated as follows:

~~5.3.1. Option 1: Based on avoided quantity of fossil fuel consumption (applicable only to biogas projects)~~

~~14. The emission reductions are calculated based on the reduced or avoided quantity of fossil fuel consumption. Emission reductions, ER_y is determined as:~~

$$ER_y = BE_y - PE_y - LE_y \quad \text{Equation (1)}$$

~~Where:~~

~~ER_y = Emission reductions during the year y (tCO_2)~~

~~BE_y = Baseline emissions during the year y (tCO_2)~~

~~PE_y = Project emissions during the year y (tCO_2)~~

~~LE_y = Leakage during the year y (tCO_2)~~

~~15. The amount of baseline emissions BE_y is calculated by:~~

$$BE_y = \sum_k \sum_j N_{k,0} \times n_{k,y} \times FC_{BL,k,j} \times NCV_j \times EF_{FF,j}$$ Equation (2)

Where:

BE_y	=	Baseline emissions during the year *y* (tCO_2)
k	=	Index for the type of thermal applications introduced by the project activity (e.g. cook stove, water heater)
j	=	Index for the type of baseline fossil fuel consumed
$N_{k,0}$	=	Number of thermal applications *k* commissioned
$n_{k,y}$	=	Proportion of $N_{k,0}$ that remain operating in year *y* (fraction)
$FC_{BL,k,j}$	=	Annual consumption of baseline fossil fuel *j* (mass or volume unit)
NCV_j	=	Net calorific value of the fossil fuel *j* (GJ/mass or volume unit)
$EF_{FF,j}$	=	CO_2 emission factor of fossil fuel *j* (tCO_2/GJ)

16. Annual consumption of baseline fossil fuel ($FC_{BL,k,j}$) can be determined using one of the two methods (a) and (b) below:

(a) Consumption of baseline fossil fuel ($FC_{BL,k,j}$), can be determined using one of the two following options:

(i) **Option (i):** Measurement for a minimum of 90 days at a representative sample of targeted users before installation/commissioning of the project equipment. The days selected for measurement of fuel consumption shall take into account seasonal variations in fuel consumption, or else the data from the measurement campaign shall be extrapolated in order to take into account the seasonal pattern of usage of the thermal application. In locations where households use fossil fuels in standard unit weights/dimensions (e.g. honeycomb coal briquettes of 500g/unit), the counting of fossil fuel units used (e.g. number of briquettes) and the unit weight[5] (e.g. unit weight of coal briquette) can be used for the purpose of measurement;

(ii) **Option (ii):** Determining the average quantity of fossil fuel consumption in a year from a representative sample survey of targeted households prior to the installation/commissioning of the project equipment. This data on annual baseline fuel consumption obtained from households shall be cross checked with purchase receipt(s) submitted by the household. The value obtained is multiplied by 0.89[6] to account for uncertainties. This option can only be applied for residential applications.

The data collected through sample-based measurements shall comply with

[5] If the unit weight is not uniform in the project area (i.e. various sizes and weights of briquettes are likely to be available in a project area with multiple manufacturers), the specific unit weights shall be applied.

[6] To account for uncertainties of the method, estimated to be in the range 30-50% (See "Annex III Table of conservativeness factors", page 25, FCCC/SBSTA/2003/10/Add.2, page 25).

the 90% confidence interval and 10% margin of error requirement. Account shall be taken of possible stratification of the sampled population (e.g. average income level, household occupancy, food or heating habits, climate/temperature zone, availability, price and type of fuel used).[7] The latest version of "Standard for sampling and surveys for CDM project activities and programme of activities" shall be complied with. Fuel consumption will be directly determined as mass or volume consumed per unit time;

(b) A baseline control group of users not supplied with the project equipment shall be set up. Relevant parameters of influence pertaining to the project region shall be defined and the control group shall be set up, taking into account these parameters (e.g. average income level, household occupancy, food or heating habits, climate/temperature zone, availability, price and type of fuel used).[7] Fossil fuel consumption of the control group is monitored throughout the crediting period, using the same sampling requirements described in Option paragraph 10.

17. Project emissions from any continued use of fossil fuel *j*,[8] are calculated by:

$$PE_y = \sum_m \sum_j N_{m,y} \times FC_{m,j} \times NCV_j \times EF_{FF,j}$$ Equation (3)

Where:

PE_y	=	Project emissions during the year *y* (tCO_2)
m	=	Index for thermal application (e.g. cook stove, water heater) not decommissioned by the project activity[9]
$N_{m,y}$	=	Number of thermal application *m* remaining in use in year *y*
$FC_{m,j}$	=	Annual consumption of fossil fuel type *j* (physical units, mass/volume) by application *m* (use 90/10 precision for sampling and sampling requirements specified for baseline sampling described in paragraph 10 above may be applied. If Option (ii) under paragraph 10 is chosen, the value obtained is multiplied by 1.12[6] to account for uncertainties)

18. Option 1 can only be applied where it can be demonstrated that the biogas digesters or the cook stoves are designed, constructed and operated to the requirements of a relevant national or international standard or comparable literature. Latest guidelines issued by a relevant national authority or an international organisation may also be used.

[7] Alternatively, the sampling design can adopt a conservative approach to account for these issues, e.g. measurement taken up during a warm season.

[8] If it can be demonstrated that the project equipment is not able to operate using fossil fuel (e.g. coal), and that the baseline equipment is decommissioned by the project activity, the project emissions may be disregarded; otherwise they shall be accounted for.

[9] *m* also includes the units introduced by the project activity, in case such units can operate with both renewable biomass and fossil fuel as inputs.

~~5.3.2. Option 2: Based on thermal energy generated~~

~~19. The emission reduction is calculated based on the thermal energy generated using the measured quantity of biomass/biogas:~~

$$ER_y = \sum_k N_{k,0} \times n_{k,y} x\ UF_b \times BS_{k,y} \times EF \times n_{PJ/BL} \times NCV_{biomass} - LE_y$$ Equation (1)

Where:

ER_y	=	Emission reductions during the year *y* (tCO_2)
$N_{k,0}$	=	Number of thermal applications *k* commissioned (number)
$n_{k,y}$	=	Proportion of $N_{k,0}$ that remain operating in year *y* (fraction)
UF_b	=	Net-to-gross adjustment factor (fraction). Apply 0.89 in cases where the operationality ($n_{k,y}$) is determined based on questionnaire survey[10]. In other cases, apply 1.0.
$BS_{k,y}$	=	The net quantity of renewable biomass or biogas consumed by the thermal application *k* in year *y* (mass or volume units, dry basis)
EF	=	CO_2 emission factor (tCO_2/GJ)
$n_{PJ/BL}$	=	Ratio of efficiencies of project equipment and baseline equipment (e.g. cook stove using coal) measured once prior to validation applying the same test procedure (e.g. lab test), as per a national or an international standard. Official data or scientific literature can be used for cross-check purposes
$NCV_{biomass}$	=	Net calorific value of the biomass (GJ/unit mass or volume, dry basis). For biogas, use default value: 0.0215 GJ/m^3 biogas (assuming NCV of the methane: 0.0359 GJ/m^3, default methane content in biogas: 60%)
LE_y	=	Leakage during the year *y* (tCO_2e)

20. The CO_2 emission factor is calculated as follows:

$$EF = \sum_j x_j \times EF_{FF,j}$$ Equation (2)

Where:

x_j	=	fraction representing fuel type *j* used by the baseline thermal applications displaced by biomass/biogas
$EF_{FF,j}$	=	CO_2 emission factor of fossil fuel type *j* (tCO_2/GJ)

~~21. $BS_{k,y}$ shall be monitored as per the requirements stipulated in Table 1Data/parameter table 6. Alternatively, project proponents may use a default biogas generation rate of 0.13 $Nm^3.m^{-3}.day^{-1}$ (i.e. volume of biogas generated in normal conditions of temperature and pressure per unit useful volume of the digester per day) for regions/countries where annual average ambient temperature is higher than 20°C.~~

[10] This is to account for uncertainties of the questionnaire survey method estimated to be in the range 30-50% (See "Annex III Table of conservativeness factors", FCCC/SBSTA/2003/10/Add.2, page 25).

5.4. Leakage

~~22. If the energy generating equipment introduced by the project activity is transferred from outside the boundary to the project activity, leakage is to be considered.~~

23. In case of biogas digesters which are not part of a Type III CDM project activity:

    (a) Any leakage due to change in manure management practice shall be taken into account, e.g. referring to methods provided in AMS-III.D. "Methane recovery in animal manure management systems";[11]

    (b) Physical leakage of biogas shall be accounted for, as per the methods specified in AMS-III.D. "Methane recovery in animal manure management systems".

24. The applicable requirements from "TOOL22: Leakage in biomass small-scale project activities" shall be followed to calculate leakage related to use of biomass.

6. Monitoring methodology

~~25. At the time of installation all project activity systems shall be inspected and undergo acceptance testing (commissioning) for proper operation in compliance with specifications. The installation date of each system shall be recorded.~~

26. Emission reductions can only be applied to systems that are demonstrated to be operational during the monitoring period and in compliance with the manufacturer's required maintenance procedures~~, at least once every two years (biennial) during the crediting period. After the inspection and acceptance testing at year of installation, the inspections can be done in years 3, 5, 7, etc. and the results of such inspections can be applied to crediting years 3 and 4, 5 and 6, 7 and 8, etc. On-going rental/lease payments or a recurring maintenance fee by users can be a substitute to actual site visits. A statistically valid sample of the residences where the systems are installed, with consideration, in the sampling design, of occupancy and demographic differences can be used to determine the percentage of systems operating, as per the relevant requirements for sampling in the "Standard for sampling and surveys for CDM project activities and programme of activities". When biennial inspection is chosen, a 95% confidence interval and 10% margin of error requirement shall be achieved for the sampling parameter. On the other hand, when the project proponent chooses to inspect annually, a 90% confidence interval and 10% margin of error requirement shall be achieved for the sampling parameter~~.

27. Relevant parameters shall be monitored as per the following section indicated in Table 1 below. The applicable requirements specified in the "General Guidelines to SSC CDM methodologies" (e.g. calibration requirements, sampling requirements) are also an integral part of the monitoring guidelines specified below and therefore shall be referred to by the project participants.

[11] Under certain situations it is possible that biogas for energy generation is sourced from a manure treatment system that replaces a pre-project manure treatment system with lesser emission intensity with a consequent net positive contribution to anthropogenic emissions. For example, animal manure treated in the baseline in 'dry lots' is now treated in 'biogas digesters' to supply biogas to the Type I project activity.

6.1. Data and parameters monitored ~~Parameters for monitoring during the crediting period~~

Data / Parameter table 1.

Data / Parameter:	$N_{k,0}$
Data unit:	Number
Description:	Number of thermal applications *k* commissioned
Source of data:	Installation records
Measurement procedures (if any):	~~As per paragraph 16~~ At the time of installation all project activity systems shall be inspected and undergo acceptance testing (commissioning) for proper operation in compliance with specifications. The installation date of each system shall be recorded
Monitoring frequency:	~~As per paragraph 16~~ Once, at the time of installation
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 2.

Data / Parameter:	$n_{k,y}$
Data unit:	Fraction
Description:	Proportion of $N_{k,0}$ that remain operating at year *y* ~~(fraction)~~
Source of data:	-
Measurement procedures (if any):	~~As per paragraph 17~~. Monitoring of operationality of the biogas systems shall be conducted using one of the following methods: (a) Census of users or survey of the users at randomly selected sample sites; (b) Based on on-going rental/lease payments or a recurring maintenance fee by users; (c) Measurement campaigns using biogas flow meters. For all cases where sampling is applied, the "Standard: Sampling and surveys for CDM project activities and programme of activities" shall be used for determining the sample size to achieve 90/10 (for annual monitoring) or 95/10 (for biennial monitoring) confidence/precision levels. For the case of measurement campaigns using biogas flow meters, it may be undertaken at randomly selected sample sites. The selected samples should take into account possible stratification of the population according to the capacity,biogas digester types and region where the digesters are installed (e.g. 6 cubic metre or 8 cubic metre capacity, fixed dome or floating dome type, regions where seasons influence average ambient temperature).

	For each measurement campaign at each site, continuous measurement shall be carried out for at least 30 days. The operational rate of each system is determined by dividing the number of days in operation by the length of the campaign. An operational day is a day in which biogas is consumed
Monitoring frequency:	~~As per paragraph 17~~ At least once every two years (biennial) during the crediting period
QA/QC procedures:	Net-to-gross adjustment factor of 0.89 is applicable in cases where the operationality is determined based on questionnaire survey i.e. when using option (a) above, to account for uncertainties.
Any comment:	-

~~Data / Parameter table 3.~~

~~Data / Parameter:~~	***~~Nm,y~~***
~~Data unit:~~	
~~Description:~~	~~Number of thermal application *m* remaining in use in year *y*, which consumes fossil fuel~~
~~Source of data:~~	
~~Measurement procedures (if any):~~	~~As per paragraph 11~~
~~Monitoring frequency:~~	~~Annually~~
~~QA/QC procedures:~~	
~~Any comment:~~	

~~Data / Parameter table 4.~~

~~Data / Parameter:~~	***~~$FC_{BL,k,j}$~~***
~~Data unit:~~	~~Physical units, mass or volume~~
~~Description:~~	~~Annual consumption of baseline fossil fuel *j*~~
~~Source of data:~~	
~~Measurement procedures (if any):~~	~~As per paragraph 10~~
~~Monitoring frequency:~~	~~As per paragraph 10~~
~~QA/QC procedures:~~	
~~Any comment:~~	

~~Data / Parameter table 5.~~

~~Data / Parameter:~~	***~~FCm,j~~***
~~Data unit:~~	~~Physical units, mass or volume~~
~~Description:~~	~~Annual consumption of fossil fuel type *j* by application *m*~~
~~Source of data:~~	

~~Measurement procedures (if any):~~	~~As per paragraph 11.~~ ~~The difference between $FC_{BL,k,j}$ and FCm,j shall be cross-checked with biogas generation estimated per a relevant national or international standard indicated in paragraph 12~~
~~Monitoring frequency:~~	~~As per paragraph 11~~
~~QA/QC procedures:~~	
~~Any comment:~~	

Data / Parameter table 6.

Data / Parameter:	$BS_{k,y}$
Data unit:	mass or volume units
Description:	The net quantity of renewable biomass or biogas consumed by the thermal application *k* in year *y*
Source of data:	-
Measurement procedures (if any):	(a) In the specific case of biogas project activities ~~opting for Option 2 (para 13)~~ using biogas flow meters ~~are used~~ to monitor accumulated biogas supplied to thermal energy equipment: • Measurement campaigns shall be undertaken at randomly selected sample sites in each year of the crediting period. • The "Standard: Sampling and surveys for CDM project activities and programme of activities" shall be used for determining the sample size to achieve 90/10 confidence/precision levels. ~~at selected sites. At least five campaigns per digester type (e.g. 6 cubic metre or 8 cubic metre capacity, fixed dome or floating dome, region with high average ambient temperature or low average annual temperature) shall be carried out in each year of the crediting period. Continuous measurement made for at least one month at a single digester is considered as a campaign.~~ ~~Monthly average value is annualised taking into account seasonal variation in gas production which is mainly a function of ambient temperature;~~ • The selected samples should take into account possible stratification of the population according to the capacity, types and region where the digesters are installed (e.g. 6 cubic metre or 8 cubic metre capacity, fixed dome or floating dome type, regions where seasons influence average ambient temperature). • For each measurement campaign at each site, continuous measurement shall be carried out for at least 30 days. • To account for seasonal variation in biogas generation from biogas digesters, it may be measured over a year during several disjointed periods (e.g. one week per quarter), but still covering at least 30 days for a year. These figures are then turned into an annual figure for a biogas digester. However, if disjoint periods are not

	practical or too expensive, then a single period may be chosen, from which an annualised figure is derived taking into account seasonality. If adjustment for seasonality is not possible, then a conservative approach shall be taken where a single period is chosen corresponding to the least amount of biogas generation, which is then scaled. • Alternatively, project proponents may use a default biogas generation rate of 0.13 $Nm^3.m^{-3}.day^{-1}$ (i.e. volume of biogas generated in normal conditions of temperature and pressure per unit useful volume of the digester per day) for regions/countries where annual average ambient temperature is higher than 20°C. (b) For the case of processed renewable biomass (e.g. briquettes) data shall be collected for mass, moisture content, and NCV ~~of briquettes that are supplied to users~~ with an appropriate sampling frequency. Cross-check with annual energy/mass balance that is based on purchased/sold quantities and stock
Monitoring frequency:	Annual
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 7.

Data / Parameter:	$NCV_{biomass}$
Data unit:	GJ/mass or volume unit
Description:	Net calorific value of biomass type
Source of data:	-
Measurement procedures (if any):	Measurement in laboratories according to relevant national/international standards. Measure the NCV based on dry biomass. Check the consistency of the measurements by comparing the measurement results with measurements from previous years, relevant data sources (e.g. values in the literature, values used in the national GHG inventory) and default values by the IPCC
Monitoring frequency:	Annual~~ly~~
QA/QC procedures:	-
Any comment:	-

6.2. Project activity under a programme of activities

28. The methodology is applicable to a programme of activities; no additional leakage estimations are necessary other than that indicated under leakage section above.

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Document information

Version	*Date*	*Description*
05.0	27 May 2021	EB 110, Annex 5 Revision to allow the use of biogas flow meters to demonstrate operationality of the biogas system remotely.
04.0	20 July 2012	EB 68, Annex 25 Revision to include a default biogas generation rate for regions/countries where annual average ambient temperature is higher than 20°C.
03.0	2 March 2012	EB 66, Annex 61 Revision to: • Remove the requirement of monitoring the project/baseline efficiency rate; • Include a correction of the NVC value of biogas.
02.0	03 June 2011	EB 61, Annex 15 Revision to: • Provide simplified options for the measurement of fossil fuel consumption; • Provide a cross-check method on the measurement of fossil fuel consumption; • Provide clarifications on calculation of CO_2 emission factor for Option 2.
01.0	18 February 2011	EB 59, Annex 2 Initial adoption.

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